FACE MASK DETECTION USING DEEP LEARNING

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Abstract:

In the Covid-19 Pandemic all countries government warned the citizens to wear a mask whenever they are away from home. They ordered not to leave house without a face mask. In every public premise, offices, in transportation the government and office officials held a face mask compulsory poster. The police and others usually warn and alert a person who does not wear a face mask. In the offices at the entrance the people are examined individually for face mask manually.

This manual checking whether a person wears a mask or not is a difficult process when the number of people increases or this will be difficult when there is a crowd, where the situation to wear a mask is mandatory. In the proposed system, the model is created using the deep learning. By this the system can detect whether a person wears a mask or not on the face. When the image is given as input to the system the model identifies a face in the image and it indicates whether a person wears a mask or not on the image. The system also works fine when there is more than one face in the image. By using this proposed model it is possible to detect whether a person wears a mask or not. This model can be used in the real world applications like Offices, Educational Institutions etc.

Keywords: Covid-19, Deep Learning, Face mask, Convolution Neural Network.

1. Introduction:

The situation report 96 of World Health Organization (WHO) presented that Corona Virus Disease 2019 (COVID-19) has globally infected over 2.7 million people and caused over 1,80,000 deaths. In addition, there are several similar large-scale serious respiratory diseases, such as Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS), which occurred in the past few years. Liu et al., reported that the reproductive number of COVID-19 is higher compared to the SARS. Therefore, more and more people are concerned about their health, and public health is considered as the top priority for governments. Fortunately, Leung et al., showed that the surgical face masks could cut the spread of Corona Virus. At the moment, WHO recommends that people should wear face masks if they have respiratory symptoms, or they are taking care of the people with symptoms. Furthermore, many public service providers require customers to use the service only if they wear masks. Therefore, face mask detection has become a crucial computer vision task to help the global society, but research related to the face mask detection is limited. Face mask detection

refers to detect whether a person wears a mask or not and the location of the face. The problem is closely related to the general object detection to detect the classes of objects and face detection is to detect a particular class of objects, i.e., the face. Applications of object and face detection can be found in many areas. Face Mask Detection is a system to identify whether a particular person wears a mask or not. This is very important at the critical times like Covid-19. The traditional method is to detect a person by looking at ones face manually, to identify whether a person wears a mask or not.

But to check and ensure that everyone wears a mask is a difficult thing, where it is totally impossible to see manually. There is a large scope for the errors i.e., the human being may miss a person who does not wear a mask. He may see a person, but at a glance, one may assume that one wears a mask.It may be difficult, when there is a large crowd. Manually it will be difficult for a person to observe individually in a crowd and ensure that everyone wears a mask.

In general people wear mask, and sometimes, at public places they may remove mask so one has to identify and alert a person to wear a mask. In the shopping malls, medical shops, hospitals and other public places, display to wear a mask is displayed and they alert people who does not wear a mask. This manual procedure of finding a person without a mask and instruct manually to wear a mask is the present scenario. But it has many disadvantages that it is very difficult for a person to identify everyone who enters a certain premises wearing a mask and without a mask to alert him is extremely difficult.

So there is a need for the automatic system which can handle these problems, the system should identify face with a mask and face without a mask. It should alert all faces without mask.

This will reduce the manual errors and alert the people without a mask, so that all will work automatically without the interference of humans. By this people become alert and protect themselves and make sure that they wear a mask and protect from the virus spread to them and to their family and community surrounded by them in the society.

2. Literature survey:

In this paper [1] the author explained how the facial mask detection can be done using semantic segmentation. In this the semantic segmentation is used in the detection of the face mask. When the image is given , on that image the semantic segmentation is performed and from the semantic segmentation the face mask is identified.

In this paper [2] the author proposed the Haar cascade classifier, the author has explained how the Haar Cascade are trained and how they can be used to detect the human face, eye, ears. The Haar Cascade classifiers are greatly helpful in the detection of the face in the various computer vision applications. This classifiers are also easy to use.

In this paper [3] the author has proposed the machine learning algorithms to detect the human face in the digital images. The author has tested

with the various algorithms in the machine learning and finally proposed which algorithm will be used for the human face detection in the images or videos. The author explained how the multiple faces can be recognized in the single image.

In this paper [4] the author has discussed about the cascade classifiers. He has explained detail about how they are trained and they can be used for the detection of human eye in the digital images, video. The author has discussed in detail about the real time eye detection system.

In this paper [5] the author explained Neural Network concept and how they are used for the development of models like Haar cascade classifiers and how these concepts can be used for the detection of the human face in the digital images.

In this paper [6] the author has explained about the various machine learning algorithms that can be used for the detection of human face in the digital images or videos. The author has used the Raspberry pi which is contain the both the memory and processor. The raspberry pi is used for reading the human face as the input and to output the result.

3.Proposed Method:

In this paper, the Convolution Neural Network is used for the implementation of the model which is used for training with the dataset and the trained model is stored for the future predictions. The objective is that the model should be able to classify whether a person wears a mask or not by taking the image or webcam feed as the input and alert person if he does not wear a mask. The steps involved in the implementation of the proposed system are:

1. Dataset Preparation
2. Model Creation
3. Training the Model
4. Storing and Evaluating the Model

Dataset Preparation:

This dataset consists of 3835 images belonging to two classes:

- With a mask: 1916 images
- Without a mask: 1919 images

The images used are real images of faces wearing masks. The images were collected from the following sources:

- Bing Search API (See Python script)
- Kaggle Datasets
- RMFD Datasets

This dataset is used for the training the model. The part of the data that is 80% is used for the training the model and 20% data set is used for the evaluation of the model created. A separate Data set of 25 images are used to test the model to know whether the model is working fine or not, some images are collected from the Google to test.

Table 3.1: Mask, Without Mask Dataset

Label	Category	Number of Images
0	With_mask	1916 images
1	Without_mask	1919 images

Model Creation:

A Sequential model is appropriate for a plain stack of layers where each layer has exactly one input tensor and one output tensor. By using the sequential method , the architecture of the model is built layer by layer, convolution layer, maxpool layer, flatten layer, drop out, dense layer.

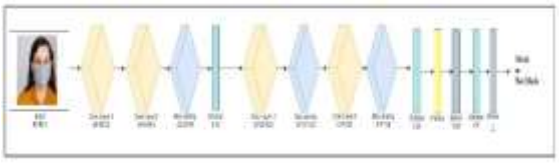

Figure 3.1: Architecture of the model

The model is created with the following layers.

- The input image is a gray scale image. ence there is only one channel.
- The size of the image is 48 *48
- Convolution layer with the images as the input, with the 'relu' activation Function, padding is valid.
- Next the Maxpooling layer is created with the size of 2*2 and the stride of 2*2,with the valid padding.
- Then the output of the max pooling layer is normalized with the Batch normalization layer.
- In the Middle of the layers a Dropout is used in order to overcome the over fitting of the model.
- In this way another 2 layers of convolution, max pooling followed by batch normalization is done.
- Then the flatten layer is implemented. This layer flattens all the outputs of the Batch Normalization layer.
- Then the flatten output are given to the next created dense layer.
- The Dense Layer is created after the flatten this will create a fully connected layer which is used for the classification.
- Then the drop out layer is created in order to reduce the number of output from layer to layer.
- Then a Batch Normalization is created.
- In this way another 2 layers of dense, dropout followed by Batch normalization is created.
- Then at last the last layer a dense layer is created with the 2 neurons, with the activation function 'Softmax'.
- The last layer give the output which specify the one of the 2 classes i.e., whether a person is with a mask or without a mask.

- **Training:**

After implementing the model the model is trained with the dataset gathered with the help of Keras fit function. Then the model is trained in specified number of epoch with the updating of neural network weights according to the batch size specified.

The SGD(Sarcastic Gradient Descent) is used for updating the weights of neurons in the network

The categorical cross entropy is used for finding the loss that has occurred between the original value and predicted value when the model is training itself with the dataset.

Evaluating and Storing the Model:

After training the model the model is evaluated with the dataset that has kept side for the evaluation. After the evaluation the model is stored in the hard disk for the further prediction of new result. Then in the future when we want to predict the new image, the image is given to the

Stored model then the model will identify the faces in the given image with the help of the Cascade classifiers identify the human faces and the human faces are used by the model to predict the weather that portion has mask or not. In this way the model works.

The user gives a image or live webcam feed as the input to the model that is created, trained and saved. Then the model identifies the face of the humans in the image and predict whether that particular person wears a mask or not and the system using openCV gives the image with bounded box around the faces of the humans in the image and above the box the mask or without mask of the particular face and the percentage of the result that the model is predicting is printed.

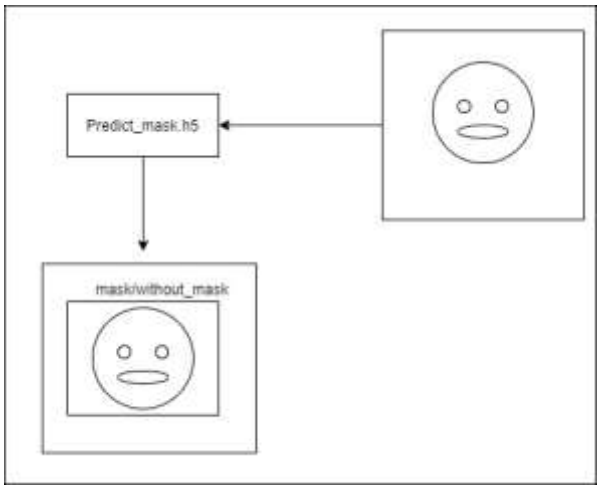

Figure 3.2: Proposed System Workflow

4.Results:

Figure 4.1: Face Mask Detection System Input

The above image is given as the input to the Face Mask Detection System. The path location of the image is give as the input to the program and the output is given as the output image.

Figure 4.2: Face Mask Detection output

The Face Mask Detection Model takes the input as the image and the output as the above image. It has identified the three faces in the image and it correctly identified faces with a

mask. It indicated with the box around the face and the mask or without the face mask on the face.

5. Conclusion:

The proposed model that has implemented using Convolution Neural Network is able to predict whether a face is with a mask or without a mask. This model will help in the situations like Covid-19 where wearing a mask is compulsory. The model takes the input as the image or the live webcam feed and tries to find faces of the people in the image or live feed and it can predict whether a face is with a mask or without a mask. It can be used for live applications like Hospitals, Shopping malls, and other Public places where the mask is mandatory. It can detect the faces of the people who does not wear a mask and alert them.

The future scope of the paper is that the model is capable of capturing the input of the **cctv** and identifies all faces without a mask and alerts with a buzzer or an alarm. In the proposed model the binary classification is either the mask or no mask. There is a possibility of not properly wearing the mask. In such cases it should alert that the face mask is improper.

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